

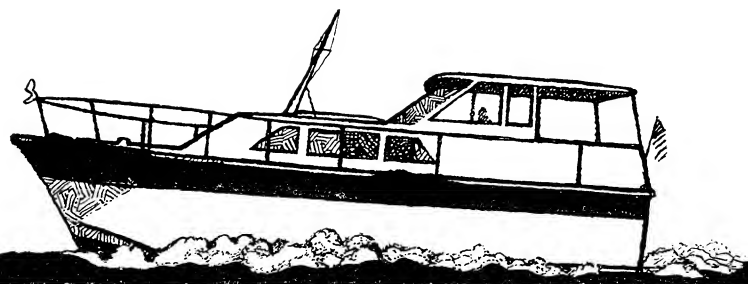
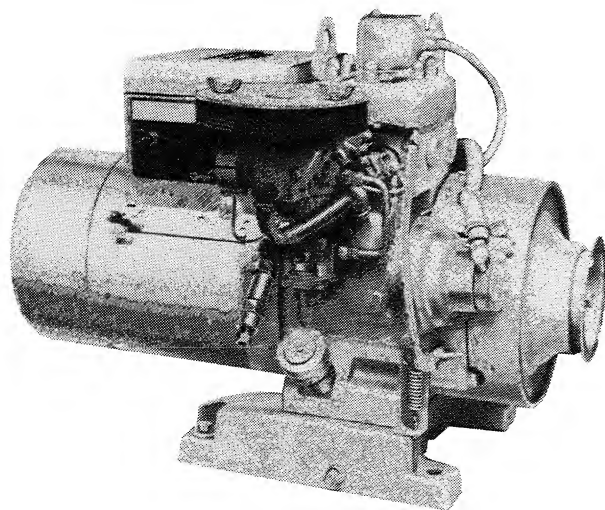


# operator's manual

**for series**

# maj

**marine electric  
generating sets**



# SAFETY PRECAUTIONS

Throughout this manual you will notice WARNING and CAUTION symbols which alert you to potentially dangerous conditions to the operator, service personnel, or the equipment itself.

**WARNING** Onan uses this symbol throughout the text to warn of possible injury or death.

**CAUTION** This symbol is used to warn of possible equipment damage.

Before operating the generator set, read the operator's manual and become familiar with it and your unit. Safe and efficient operation can be achieved only if the unit is properly operated and maintained. Many accidents are caused by failure to follow simple and fundamental rules or precautions.

- Don't fill fuel tanks with the engine running. Don't smoke around generator set area. Wipe up any oil or gas spills. Don't leave oily rags in engine compartment or on the generator set. Keep this and surrounding area clean.
- Equip the engine fuel supply with a positive fuel shutoff for a remote fuel supply source. Onan has optional positive fuel shutoff solenoids available.
- Provide adequate ventilation (preferably power exhausters) to expel toxic gas fumes and fuel vapors from the engine compartment. Be sure propulsion and generator engine exhaust systems are free of leaks.
- Perform thorough, periodic inspections of the exhaust system and repair leaks immediately. Exhaust gases are deadly.
- Coolants under pressure have boiling points over 212 F (100 C). Don't open a coolant pressure cap while the engine is running. Always bleed off the system pressure first. Don't remove any belt guards or covers with unit running.
- Keep hands and loose clothing away from moving parts. Don't wear jewelry while servicing any part of the generator set.
- Never step on the generator set (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions . . . from leaking fuel, leaking exhaust fumes, etc.
- Before performing any maintenance on the set, disconnect its batteries to prevent accidental starting. Don't smoke while servicing batteries. Hydrogen gas given off during charging is explosive. Make sure you connect the battery correctly. A direct short across the battery terminals can cause an explosion. Connect the ground lead last.
- Don't make adjustments in the control panel or on engine with unit running. High voltages are present. If you must work around unit while it is running, stand on dry surfaces to reduce shock hazard.
- Keep a fire extinguisher available in or near the engine compartment and in other areas throughout the vessel. Use the correct extinguisher for the area. For most types of fires, an extinguisher rated ABC by the NFPA is available and suitable for use on all types of fires except alcohol.
- Onan suggests posting these suggestions in potential hazard areas of the vessel. Most important, exercise caution and use common sense.

## 933-1002 SUPPLEMENTAL INSTRUCTIONS

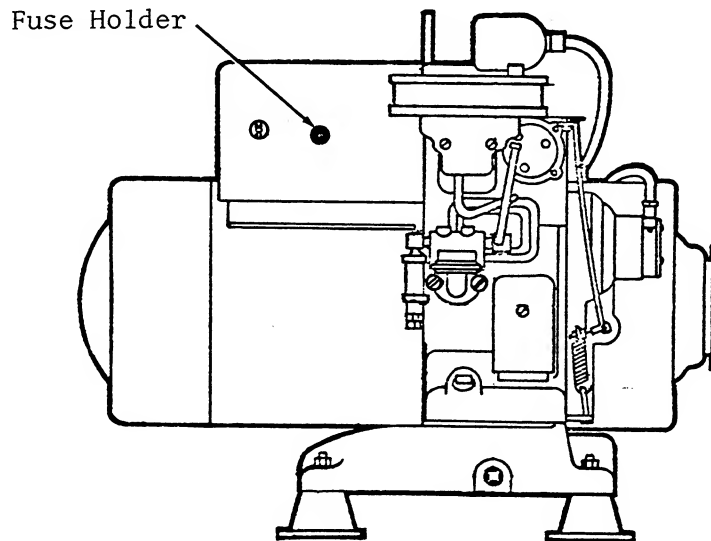
TO

MAJ OPERATOR'S MANUAL 933-0120

These supplementary instructions apply to the 933-0120 Operator's Manual for MAJ marine electric generator sets starting with serial number J770266778. Use the instructions in addition to those given in the manual.

The above referenced generator sets have a fuse holder and fuse mounted on the control box. The fuse is in the battery B+ circuit and provides lead protection in case of an overload.

If the fuse fails, the battery will not receive charging current from the generator, and in time become discharged. Replace fuse with another of the same ampere rating - Buss AGC 10 Amp.



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## GENERAL INFORMATION

### YOUR MANUAL

This manual gives you operation and maintenance instructions to help you keep your unit running like new. Read it carefully. Remember . . . any machine, regardless of design or type, performs only in relation to the services it gets.

Throughout the manual, engine end is considered front of the generator set. Left and right are determined while facing the engine end.

Where applicable, metric equivalents appear in parentheses following the U.S. customary units.

### YOUR GENERATOR SET

Upon receipt of your unit, check it thoroughly for any damage which may have occurred during shipping. Tighten any loose parts, replace missing parts, and repair any damage before putting the unit in operation.

Identify the model of your unit by referring to the model and specification number shown on the Onan nameplate. Electrical specifications are shown on the lower portion of the nameplate.

# SPECIFICATIONS

## GENERAL DETAILS

### Engine

Number of cylinders .....	1
Displacement.....	14.9 cu. in. (244 cm <sup>3</sup> )
Cylinder bore .....	2.75 in. (69.85 mm)
Piston stroke .....	2.5 in. (63.5 mm)
RPM (60 Hz) .....	3600
Compression ratio .....	6.25 to 1

### Generator

Voltage .....	120 VAC
Phase .....	1
Wire .....	2
Hertz .....	60 Hz
Maximum Rating	
Watts .....	3000
Amperes .....	25.0
Continuous Rating	
Watts .....	2500
Amperes .....	20.8

## CAPACITIES AND REQUIREMENTS

Battery Voltage.....	12
Battery size	
Two 6-volt batteries in series .....	SAE group 1H
SAE rating - 20 hours (nominal) .....	105 amp/hr (378 kC)
Battery charge rate (normal) .....	1.5 to 2 amperes
Oil capacity.....	3.5 pts. (1.66 lit)
Total air per minute required (cooling and combustion) .....	76 cu ft (2.15 m <sup>3</sup> )
Cooling water flow per minute .....	3.4 quarts (3.2 lit)

## TUNE-UP SPECIFICATIONS

Clearances given at room temperature of 70 F (21 C).

Spark Plug Gap .....	0.025 in. (0.64 mm)
Ignition Breaker Point Gap @ Full Separation .....	0.022 in. (0.56 mm)
Magneto Pole Shoe Air Gap .....	0.010 in. (0.25 mm) to 0.015 in. (0.38 mm)
Ignition Timing Advance .....	25° BTC

# INSTALLATION

## GENERAL

Each installation must be considered individually and made in compliance with existing regulations. Figure 1 shows a typical installation. The advice and guidance contained in the booklet entitled *Fire Protection Standard for Motor Craft*: (NFPA No. 302) offered by the National Fire Protection Association International, Boston, Massachusetts, will be helpful to the installer of equipment in vessels.

## LOCATION

Select a location for the unit, preferably near the main keel of the vessel, which is dry, properly ventilated and above low lying vapors or splash from the bilge. Provide accessibility for minor servicing operations, draining of the crankcase lubricating oil and of the cooling system.

## MOUNTING

The floor should be flat and give support directly under the set mounting points. A 2-1/2 inch (64 mm)

clearance around the unit is required to permit rocking on its mounts without restraint. Use adequate flexible exhaust line, fuel line, battery cables, and electrical wires.

A wood or metal base is suitable for mounting the unit if it is strong enough to prevent transmission of vibration to the hull and yet support the generator set under severe operating conditions. To prevent transmission of vibration, the mounting base should not touch any part of the bulkheads or freeboards.

Engine stringers normally are the best support in the boat for a mounting base. You can use other equivalent stringers, but use caution about using hull frames. They are often not strong enough to prevent transmission of generator set noise to the hull.

Vibration isolators are furnished with the generator set. Place them under the engine oil base and generator mounting feet as shown in Figure 2 and secure the vibration isolators to the mounting base. The isolators include detailed instructions on mounting.

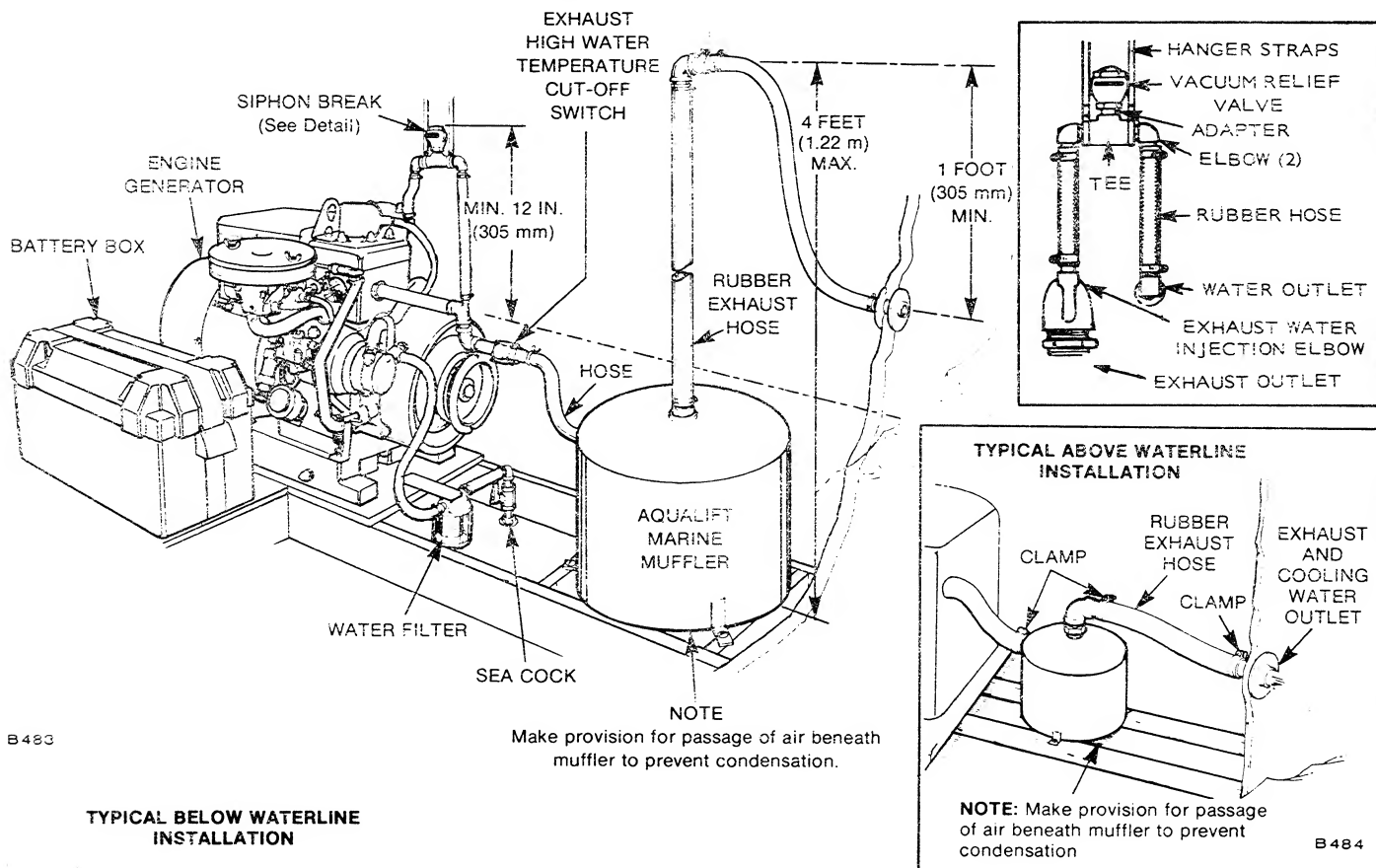


FIGURE 1. TYPICAL MAJ GENERATOR SET INSTALLATION

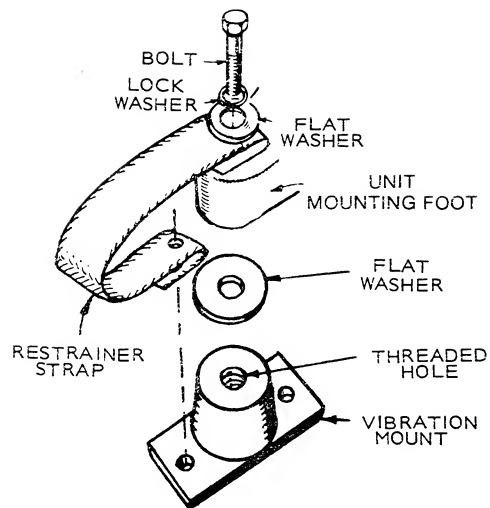
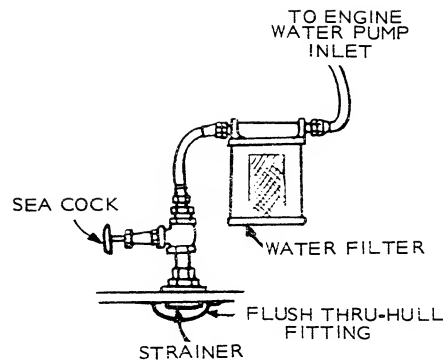


FIGURE 2. VIBRATION ISOLATOR



**CAUTION**

DO NOT USE SCOOP TYPE WATER INLET FITTINGS FOR UNITS USING AQUALIFT MUFFLER SYSTEMS.

FIGURE 4. RECOMMENDED FLUSH-TYPE, THRU-HULL FITTING AND WATER FILTER

## WATER LINES

### Supply Line

A continuous supply of cooling water is required. The water pump inlet has a 1/8-inch U.S. national pipe fitting (see Figure 3). Use a section of flexible hose on the water inlet next to the generator set (or the entire run), either of copper tubing or flexible hose which will not collapse. The tubing must have an inside diameter of at least 1/8 inch or larger. Use Permatex or other pipe sealer on all pipe fittings in the supply line to the water pump.

For pipe runs longer than 5 feet (1.6 m), reduce resistance by using larger inside diameter plumbing. Install a strainer in the water line inlet where accessible for cleaning. Figure 4 shows a recommended flush-type, thru-hull fitting and water filter.

To prove the water inlet plumbing is air tight, see that no bubbles appear in the discharged water after completing the installation.

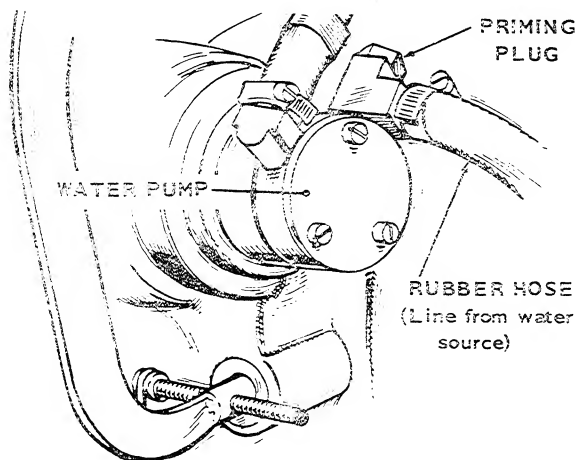


FIGURE 3. INLET HOSE TO WATER PUMP

### Discharge Line

The 1/4-inch U.S. national pipe size water outlet is on the front of the cylinder head (Figure 1). Use discharge plumbing at least as large as the supply line and use a section of flexible hose near the generator set (or entire run). Connect the line so the water discharges into the exhaust line at least several feet (about a metre) ahead of the muffler (other details given under *Exhaust*). Be sure the water will not back-flow into the exhaust line and engine port.

## EXHAUST

### General

All exhaust systems for water-cooled marine installations must meet these requirements:

1. Except for vertical dry stack systems, exhaust systems must be water cooled, the water injected as near to the generator set as possible.
2. All exhaust system sections preceding the point of cooling water injection must be either water jacketed or effectively insulated.
3. The exhaust line must be installed so as to prevent back flow of water to the engine under any conditions, and the exhaust outlet must be above the load waterline. Water flowing back to the engine will damage it.
4. The generator set's exhaust system must not be combined with the exhaust system of any other engine.
5. An approved, flexible, non-metallic exhaust line section should be used near the engine to allow for engine movement and vibration during operation.

6. Vertical dry stack exhaust systems must have spark arresters. The exhaust system between engine manifold and spark arrester must be either water jacketed or well insulated.

**WARNING**

Use extreme care during exhaust system installation to insure a tight exhaust system. Exhaust gases are deadly.

## Material

Either cast iron or wrought iron piping is recommended for exhaust lines. Use exhaust line at least as large as the engine exhaust outlet but increase the entire line one pipe size for each ten feet (3 m) in length. On gasoline installations, copper tubing is acceptable providing it is approved for marine installation. To prevent vibration from transmitting to hull, use automotive type tail pipe hangers. Most installations today use flexible rubber hose for the water cooled section of the exhaust line because of the ease of installation and flexibility. Be sure the rubber hose used is designed and approved for exhaust line use, such as heavy duty single braid reinforced rubber hose. Provide adequate support for rubber hose to prevent sagging, bending and formation of water pockets.

The flexible section of the exhaust line should be installed between the engine and muffler (Figure 1). Do not connect the muffler directly to the exhaust

manifold. Use rubber hose only in the water-cooled sections of the exhaust system. Do not install rubber hose with sharp bends as this will reduce efficiency and may cause hose failure. Metallic flexible line is not recommended except in below water line or dry pipe installations. When using metallic flexible exhaust line, install in straight lengths only. The MAJ engine exhaust connection is 3/4-inch pipe tapped.

## Exhaust Water Injection

Cool the exhaust with the full generator set cooling system water output. Provide a tee for the water line connection as shown in Figure 5. Because in most cases, you can't install the exhaust line with enough downward pitch to prevent water from pouring into the engine, a baffle of some type must be included in the exhaust line.

**WARNING**

Do not use the manifold as a muffler support because it puts excessive strain on the connecting exhaust line and can cause it to break, resulting in the escape of deadly exhaust gases.

A high temperature exhaust shutdown switch should be used for all types of marine installations (Figure 5). It mounts on the exhaust line and can be connected to shut down the generator set if the exhaust overheats (at approximately 240 F or 115 C). The exhaust temperature cutoff switch connects in series with the high water temperature shutdown switch on the engine cylinder block.

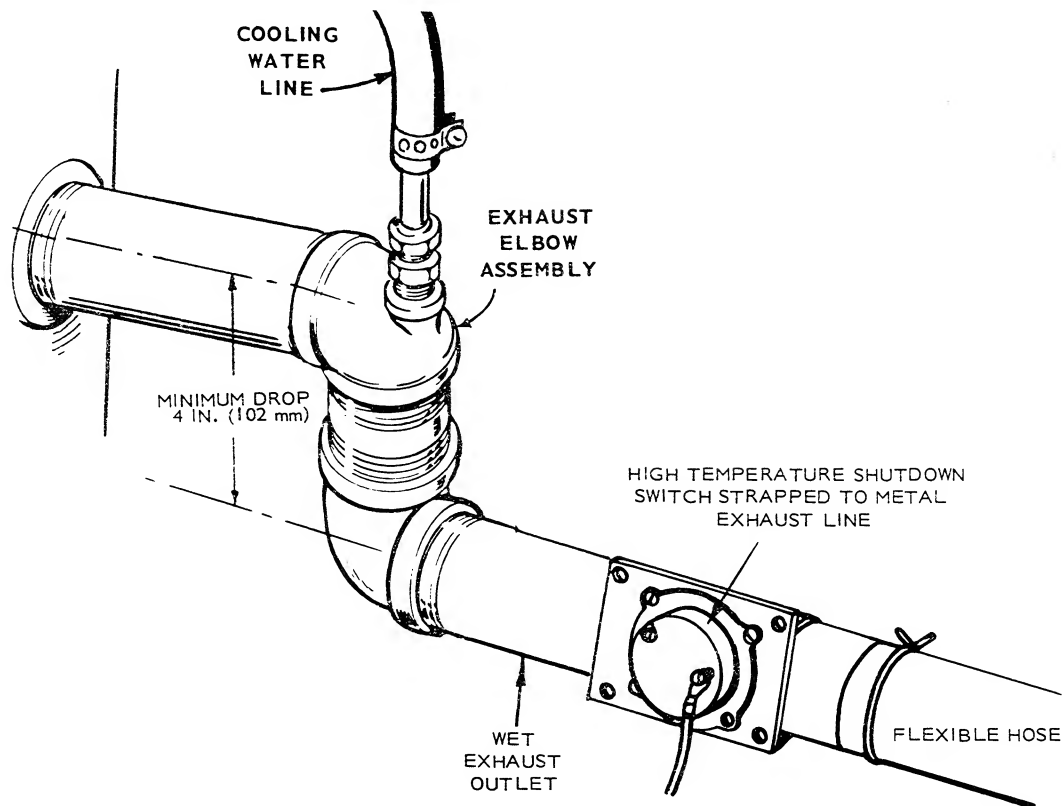


FIGURE 5. TYPICAL EXHAUST WATER INJECTION SYSTEM



## Siphon Break

The siphon break or anti-siphon is a vacuum-operated vent valve that opens the exhaust water discharge line to the atmosphere when the engine shuts down. The open vent valve prevents floatation water (sea water) from being siphoned into the exhaust manifold and cylinders on engines installed below the load water line (Figure 1). The siphon break is required in the raw water discharge line for direct flow, Aqualift muffler, and heat exchanger installations.

### CAUTION

Install a siphon break kit 155-0950 if exhaust injection elbow is below load water line.

Locate the siphon break at least 12 inches (305 mm) above the load water line and in a vertical position. Remote mounting the siphon break is permissible within a 5-foot (1.5 m) radius of the water injection exhaust elbow. Vertical position and height of valve must be maintained.

### CAUTION

Be sure the slotted opening in the vacuum relief valve is open to atmospheric pressure. The siphon break will not function if the relief valve slot is closed in any way.

## Aqualift® Muffler

Onan recommends using the Aqualift muffler for maximum silencing efficiency and ease of installation. It is designed for above or below water line installations when water-cooled exhaust systems are used. Because of installation variations, the customer must furnish the brackets and clamps for the installation.

### CAUTION

Do not use a scoop-type water inlet fitting. When the boat is underway and the generator set is not running, sufficient ram pressure can force water past the engine water pump, flooding the exhaust system, and possibly flood the engine cylinders.

## FUEL TANKS AND LINES

If a separate fuel tank is used, install it so the bottom of the tank will be less than four feet (1.22 m) below the fuel pump. To prevent siphoning if a system leak occurs, position the tank below the level of the engine pump, or use a siphon break system (see *Fuel System Siphon Break* following). A shutoff valve at the tank and near the generator set is recommended for service convenience (Figures 6 and 7). Use the U.S. Coast Guard approved flexible fuel line between the solid fuel line and engine to absorb vibration (Figure 8). Make sure the solid fuel line is grounded as shown in Figure 8. Also installing a shutoff valve at the tank and near the generator set for service is recommended.

All fuel tanks must be electrically bonded to the boat ground. Also bond the filler neck to the tank if a hose is used between them.

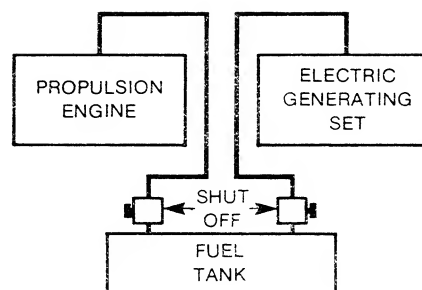
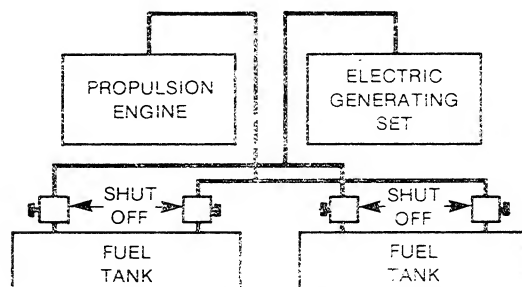


FIGURE 6. SINGLE FUEL TANK INSTALLATION

### WARNING

Leakage of gasoline in or around the compartment is a definite hazard. The ventilation system should provide a constant flow of air to expel any accumulation of fuel vapor while the vehicle is in transit. Compartments must be essentially vapor-tight to keep fumes (which could explode) from within the vessel.



B485

FIGURE 7. DUAL FUEL TANK INSTALLATION

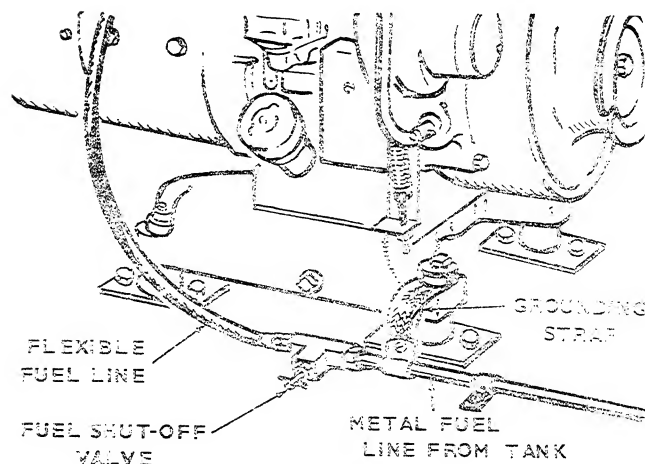


FIGURE 8. TYPICAL FUEL LINE SYSTEM AT GENERATOR SET

Most gasoline marine fuel tanks have an anti-siphon orifice drilled near the top of the fuel output pipe before installation. Because of the relatively small fuel draw of the generator set's fuel pump, it draws only the air from the orifice when used alone with a tank designed for the main engines. This is one of the reasons for using a separate fuel tank connection for the generator set. However, if the proper size orifice is used (about #75) in either a separate tank or a separate outlet from the main tank, it will function as a siphon break. See Figure 9.

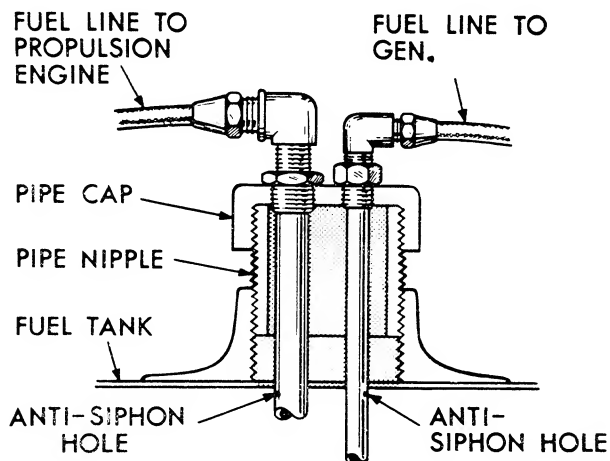


FIGURE 9. LOCATION OF ANTI-SIPHON HOLE IN FUEL SYSTEM

## Auxiliary Electric Fuel Pump

If vertical fuel lift exceeds 4 feet (1.22 m), or vapor lock occurs, install an auxiliary electric fuel pump near the fuel supply.

## VENTILATION

Generator sets require fresh air for combustion and generator cooling. Onan recommends that the ventilation system be able to deliver 1-1/2 to 2 times the air required by the set. When the ventilation system depends on wind or boat motion, use powered exhausters to provide ventilation when the boat is not in motion. For more information, refer to Onan Technical Bulletin T-021.

## LOAD CONNECTIONS

The nameplate shows the electrical output rating of the unit. The wiring diagram shows the electrical circuits and connections necessary for the available output voltage. Also see Figure 10.

Meet all applicable code requirements. Work should be performed by a qualified serviceman and electrician because the installation may be inspected for official approval. Use sufficiently-large insulated wires, stripping the insulation from the ends for clean connections. Connect each load wire to the proper generator output lead inside the generator set connection box (marked "M1," "M2," etc.), and insulate bare ends of ungrounded wires.

Use flexible conduit and stranded load wires at the generator set to absorb vibration.

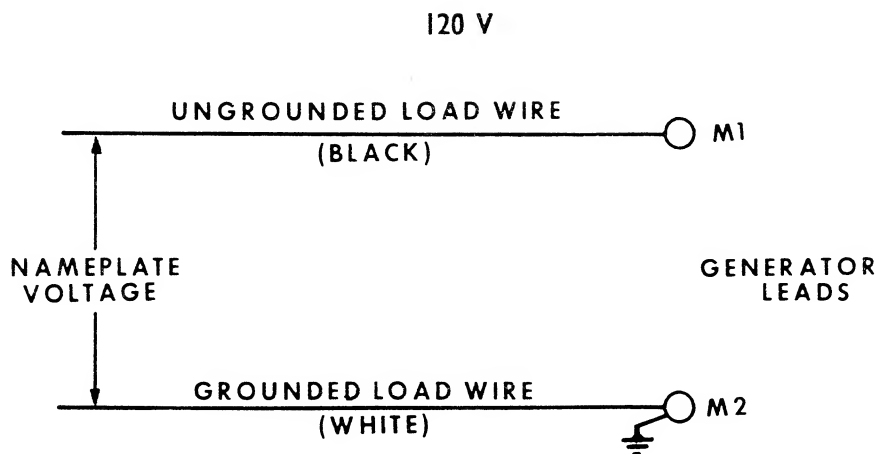


FIGURE 10. LOAD WIRE CONNECTIONS

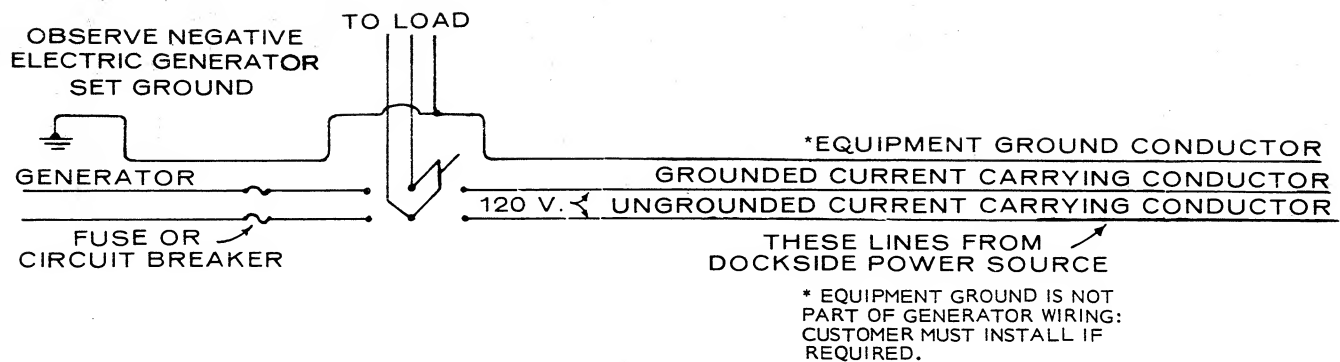


FIGURE 11. SHORE POWER WIRING CONNECTIONS

## Equipment Ground

The installation may include an equipment ground which includes a common ground for all the electrical equipment aboard the vessel. Connect this ground to the ground connection on the generator. Do not tie this ground to the generator current-carrying conductor.

## Shore Power

If the installation connects to shore power, install a double-throw transfer switch (either automatic or manual), such as an Onan 308-0269, 2-pole or 308-0270, 3-pole manual switch. This type of switch will prevent feeding generator output to shore power lines and also prevents connection of shore power and

generator output to the load at the same time. See Figure 11.

## REMOTE START-STOP CONNECTIONS

For remote control of starting and stopping, use three wires to connect a single-pole, double-throw, momentary contact (center-off type) remote switch to the terminal block marked "B+," "1," "2," "3," and "4" in the generator control box (Figure 12). Use the correct wire size according to the distance to the remote switch as shown in Figure 12.

More than one remote switch can be used to start and stop the generator set if they are wired in parallel.

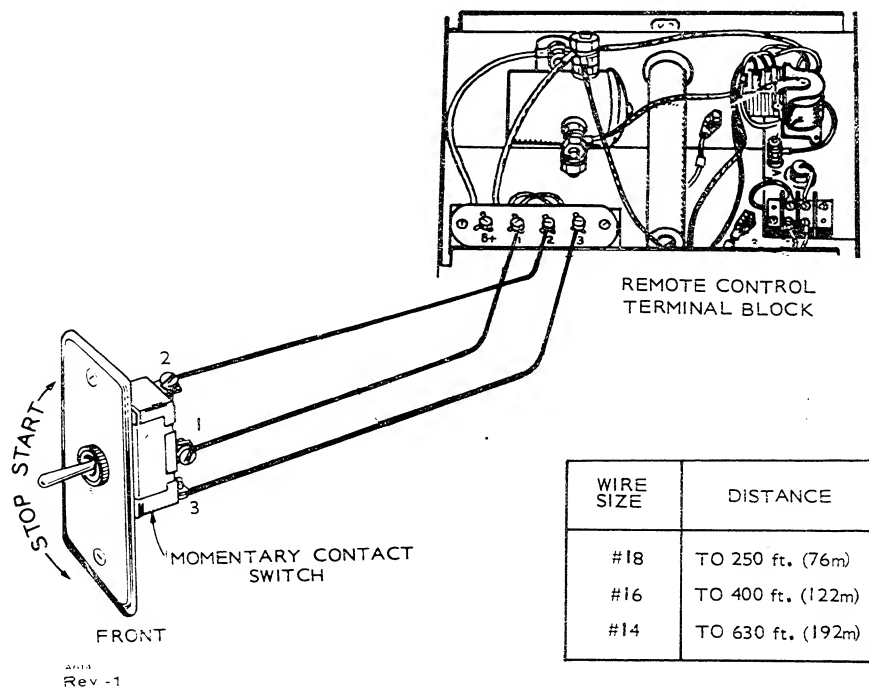


FIGURE 12. REMOTE START-STOP CONNECTIONS

## BATTERIES

Install the unit batteries as close as possible to the unit but not directly under the generator. If installed in a separate compartment, be sure the compartment is well ventilated to prevent any accumulation of hydrogen gas generated during battery charging. Mount the batteries in an acid resistance tray on a platform above the floor and secure them to prevent shifting. If batteries are in the engine compartment, always install a non-metallic cover over them to prevent accidental sparks from objects dropped on the batteries.

## BATTERY CONNECTIONS

### CAUTION

Before connecting the battery, make sure the engine has oil in the crankcase, the water pump has been primed and in general, the unit has been serviced for operation. Otherwise, engine damage could occur if the engine is started.

Connect the battery positive (+) cable from one six-volt battery, positive terminal, to the start solenoid terminal marked "B+" in the generator control box. See Figure 13. Connect the jumper cable from the negative (-) terminal of the same battery to the positive terminal of the second six-volt battery. Connect the last battery cable between the negative terminal of the second battery and the ground terminal on the generator.

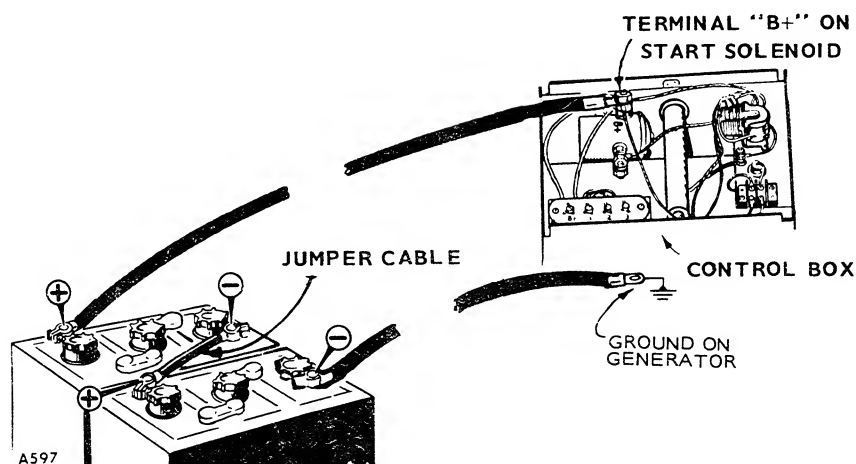


FIGURE 13. BATTERY CONNECTIONS

# OPERATION

## WARNING

### ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

## INITIAL START

1. Make sure the water pump has been primed (Figure 3 of *INSTALLATION* section).
2. Check to make sure the engine oil base has oil — filled to "FULL" mark on oil indicator (see *PERIODIC MAINTENANCE* section) with oil recommended.
3. Check to make sure engine has supply of fuel — fuel recommended under *Gasoline Fuel*. You can hand prime the engine fuel system using the fuel pump priming lever (Figure 14).

If the camshaft pump lobe is up (fuel pump priming lever operates with very little resistance), crank engine one revolution to permit hand priming. When finished, return priming lever inward to permit normal pump operation.

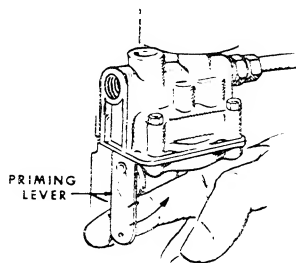


FIGURE 14. PRIMING LEVER ON FUEL PUMP

## CRANKCASE OIL

Oil capacity of the MAJ generator set is 3.5 pints (1.66 lit). Fill the crankcase until oil reaches the "FULL" mark on the oil level indicator.

Use an oil with the API (American Petroleum Institute) designation SE or SE/CC. If this oil is not available, SD or SD/CC designated oil can be used. Recommended SAE oil numbers (weights) for expected ambient temperatures follow.

Above 90 F (32 C) .....	SAE 50
32 to 90 F (0 to 32 C) .....	SAE 30
0 to 32 F (-18 to 0 C) .....	SAE 10W-40, 5W-30
Below 0 F (-18 C) .....	SAE 5W-30

When adding oil to the engine between changes, use the same brand as in the crankcase. Various brands of oil might not be compatible when mixed. Refer to the *PERIODIC MAINTENANCE* section for recommended oil changes and complete oil recommendations.

## GASOLINE FUEL

The engine will work most satisfactory on unleaded gasoline or regular-grade gasoline. However, non-leaded gasoline is better for the engine. Before switching to unleaded gasoline after having used a

leaded gasoline (e.g. regular), note the following caution.

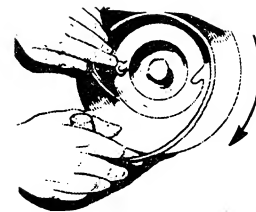
**CAUTION**

1. Do not use unleaded gasoline after having used leaded gasoline. Otherwise, preignition could occur and cause engine damage.

2. Switching from leaded to unleaded gasoline requires first removing lead deposits from the engine. Contact your nearest Onan service representative for more information.

**WARNING**

Due to the danger of fire or explosion, never fill the fuel tank with either the propulsion or generator set engine running. Because of gasoline fumes, sparks, flames, etc., should not be used near the fuel system without great caution.



WIND STARTING ROPE ON SHEAVE  
IN CLOCKWISE DIRECTION.  
(Refer to starting instructions)

FIGURE 15. USING START ROPE ON ENGINE

## STARTING

### Electric or Remote Electric Starting

For starting at the generator set or remote starting at a remote location on the vessel, use the following procedure.

1. Push the start-stop switch, either the remote switch or one on generator set, to "START."
2. As soon as the generator set starts, release the switch.

### Automatic Starting and Stopping

If an automatic demand control is used with the MAJ generator set, a load circuit will automatically start the generator set. When all loads are removed, the generator set is automatically stopped.

For more information on this type of operation, see the operator's manual which is supplied with the automatic demand control.

### Manual Starting With Batteries Connected

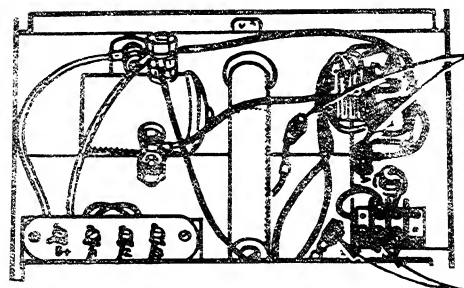
This manual starting procedure is for a generator set with the starting batteries connected. If the generator set must be started without the batteries connected, use the procedure given under *Manual Emergency Starting Without Batteries*.

1. Wind the starting rope clockwise on the rope sheave as shown in Figure 15.
2. Pull the rope slowly until the piston passes over compression.
3. Rewind the rope to starting position.
4. Pull the rope with a fast pull to crank engine.

### Manual Emergency Starting Without Batteries

If the starting batteries are connected, follow the procedure given under *Manual Starting With Batteries Connected*.

1. Remove the cover on the generator set control box.
2. Disconnect generator lead A1 from terminal A1 and disconnect wire 4 from the small terminal block. See Figure 16.



DISCONNECT GEN.  
LEAD "A1" FROM  
TERMINAL "A1"

DISCONNECT LEAD  
NO. 4

FIGURE 16. REMOVAL OF TWO LEADS IN  
CONTROL BOX

3. Disconnect the electric choke wire at the choke.
4. Tape all loose terminals of the disconnected wires.
5. Mark the electric choke setting on the choke cover and on the choke body. Then loosen the two screws and readjust to a fully open position. Operate the choke manually while the battery is disconnected (Figure 17).
6. Use the manual starting procedure given under *Manual Starting With Batteries Connected*.

When batteries are again connected for operation, make sure to reconnect wire leads and reset choke to original position.

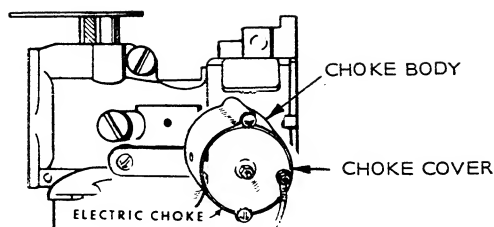


FIGURE 17. AUTOMATIC ELECTRIC CHOKE

## Break-In Procedure

For a new or reconditioned generator set, run the unit in the following sequence.

1. One-half hour at 1/2 load.
2. One-half hour at 3/4 load.
3. Full load.

This method of load application speeds piston ring seating. Continuous running at light load during the first few hundred hours usually results in poor ring seating and higher oil consumption.

## SAFETY DEVICES

In case of high coolant (water) temperature, a shut-down switch stops the generator set. After an emergency stop, find the trouble and correct.

## STOPPING

1. After load is removed from the generator set, let it run a few minutes to cool.
2. Stop the generator set by pushing the start-stop switch, either the remote switch or one on generator set, to "STOP."

## OUT-OF-SERVICE PROTECTION

If the generator set will be out of service for more than 30 days, protect it by using the following procedure.

1. Start and run the generator set until it is thoroughly warm.
2. Turn off the fuel supply and run the generator set until it stops.
3. Disconnect the starting batteries and follow the standard battery storage procedure.

**CAUTION** When batteries are in storage, maintain liquid level and use a trickle charger to maintain specific gravity. Otherwise, if exposed to freezing temperatures, severe damage can occur to the batteries.

4. Drain the oil from the oil base while the engine is still warm. Refill the oil base with clean oil and attach a caution tag stating the oil used.
5. Remove the spark plug and pour 1 ounce (about 3 ml) of rust inhibitor oil (or SAE 50 oil) into the cylinder. Crank engine slowly by hand several times and install the spark plug.
6. Remove the resonator and clean the flame arrester in soap and water. See *PERIODIC MAINTENANCE* section. Rinse, dry with compressed air and reinstall on the generator set.
7. Drain the water from the engine and water pump if danger of freezing exists. See *Draining Cooling System*.

## TO APPLY LOAD

1. If possible, let the generator set run a few minutes without load to allow for engine warm-up.
2. Connect the load to the generator set. Try to connect the load in steps instead of full load at one time.

**CAUTION** While the generator set can temporarily handle an overload, continuous overloading may cause high operating temperatures and damage the generator windings. Keep the load within nameplate rating.

Because the engine runs at constant speed, the exhaust system may form carbon deposits during prolonged operation with light loads. Apply full load occasionally to prevent excessive carbon accumulations.

## POWER REQUIREMENTS FOR APPLIANCES

Appliance	Approximate Running Wattage
Air Conditioner.....	1400-2200
Coffee Percolator.....	550-700
Electric Blanket .....	50-200
Electric Frying Pan .....	1000-1350
Electric Iron.....	500-1200
Electric Water Heater .....	1000-1500
Electric Water Pump .....	500-600
Hair Dryer.....	350-500
Microwave Oven.....	700-1500
Radio .....	50-200
Refrigerator .....	600-1000
Space Heater.....	1000-1500
Television .....	200-600
Vacuum Cleaner.....	500-1500

8. Remove the flexible section of the exhaust line (where water cooled) and plug engine exhaust outlet to prevent entrance of moisture and dirt. Attach a warning tag to exhaust line noting exhaust outlet is plugged.
9. Wipe the generator brushes, slip rings, etc. Do not apply lubricant or preservative.
10. Clean and wipe the entire unit. Coat parts susceptible to rust with a light coat of oil or grease.

### Returning the Unit to Operation

1. Remove any dust and dirt from the generator set.
2. Check the fuel line connections and check the fuel tank for moisture. Drain if necessary and fill with fresh fuel.
3. Check the engine oil for moisture. If there is no moisture and the oil type and weight marked on the tag is correct, the oil is okay for operation. Otherwise, drain and refill with new oil.
4. Remove the flame arrester. If the flame arrester is dirty, wash in soap and water, rinse and dry with compressed air. Then reinstall on the generator set.
5. Service the cooling system with clean and fresh water. Prime the water pump and see that all air is bled from the system.
6. Remove material used to plug the exhaust outlet and reconnect the exhaust line. Check complete

exhaust system for tight connections and condition of muffler, exhaust line, etc.

**WARNING** Be sure to connect the exhaust line, make sure the exhaust system is fit for operation and will not leak. Exhaust gases are deadly.

7. Check the entire generator set for water, fuel, or oil leaks. Correct leakage as required.
8. Check wiring system for worn wires, loose connections, etc. Remedy as required.
9. Install the fully-charged batteries and connect to the generator set. Observe correct polarity.

### DRAINING COOLING SYSTEM

1. To drain the water pump, loosen the cover on the water pump so the water runs out. See Figure 18.
2. Loosen the hose clamp on the hose, from the water pump, at the engine inlet connector. Then pull the hose from the connector to let water drain from the engine.

Loosening the engine water outlet fitting may speed draining the engine. Remember to tighten fitting when finished.

3. Pull necessary fittings loose to drain water from the rest of the system (water inlet lines, water-cooled muffler, outlet lines, etc.).
4. After the cooling system is completely drained, reconnect and tighten all hoses, fittings, and clamps.

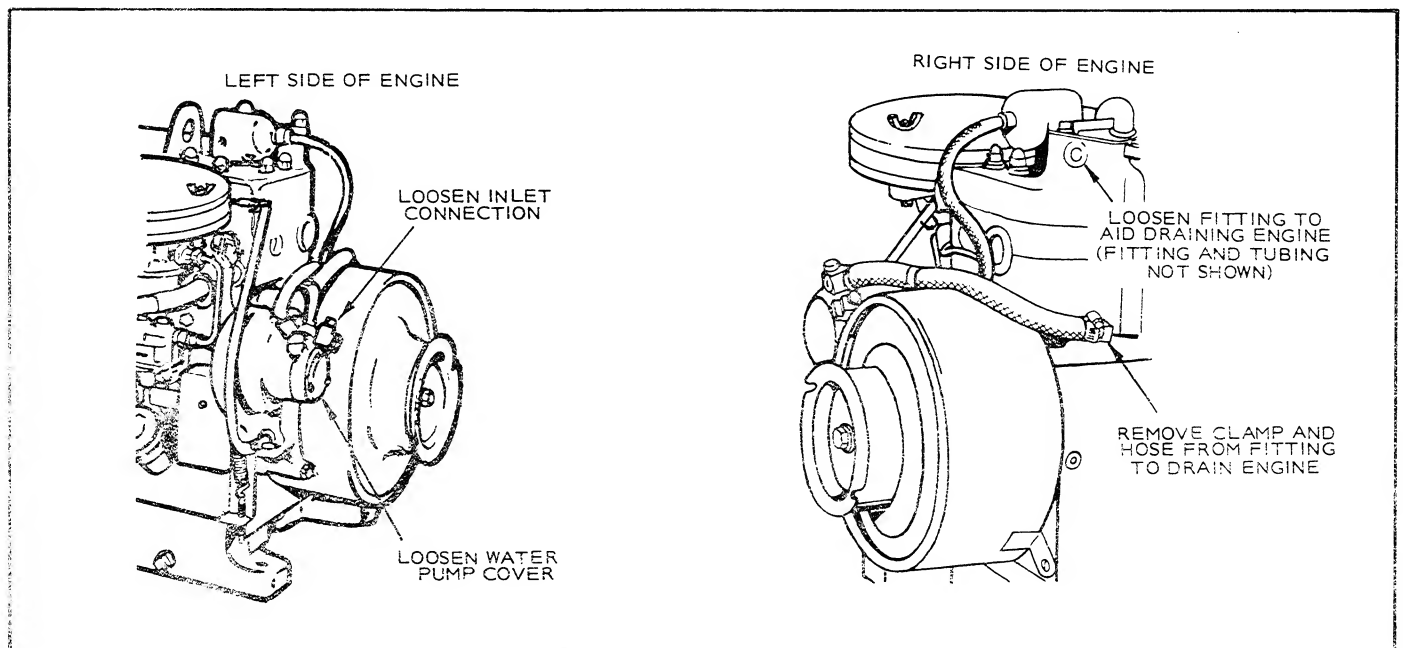


FIGURE 18. DRAINING WATER PUMP AND ENGINE COOLANT



## LOW TEMPERATURE CONDITIONS

1. Use a light weight oil as shown in the *PERIODIC MAINTENANCE* section. Change oil only when the engine is warm.

Failure to use a lighter weight oil in cold weather results in hard cranking and a chance the unit won't start.

2. Use fresh fuel and keep the fuel tank full as much as possible. A full tank prevents moisture condensation.
3. Keep the fuel system clean.
4. Exercise the generator set frequently (see *EXERCISING*).

## EXERCISING

Infrequent generator set use can result in hard starting. To ensure starting ability, operate your generator set at least 1/2 hour every week, if possible (operate longer if battery is weak). Periodic exercising will keep the battery charged and will keep fuel at the carburetor fresh.

## HIGH TEMPERATURE CONDITIONS

1. See that nothing obstructs air flow to-and-from the unit.
2. Keep cooling system clean.
3. Keep ignition timing properly adjusted.
4. Use proper weight oil as listed in *PERIODIC MAINTENANCE* section.

## DUSTY OR DIRTY CONDITIONS

1. Keep generator set clean. Keep cooling system clean.
2. Service flame arrester as frequently as necessary (see *PERIODIC MAINTENANCE* section).
3. Reduce oil change schedule (*PERIODIC MAINTENANCE* section).
4. Keep governor linkage clean (*PERIODIC MAINTENANCE* section).
5. Clean generator brushes, slip rings and commutator. Do not remove normal (dark brown) film. Do not polish. See *PERIODIC MAINTENANCE* section.

# PERIODIC MAINTENANCE

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. Use the following schedule as a guide. However, actual operating conditions under which a unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions reduce some of the service periods. Check the condition of the crankcase oil, the filters, etc. frequently until you can establish the proper service time periods.

For any abnormalities in operation, unusual noises from engine or accessories, loss of power, overheating, etc. contact your nearest dealer.

## PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS						
	8	50	100	200	500	1000	5000
Inspect Generator Set	x1						
Check Fuel Supply	x						
Check Oil Level	x						
Check Flame Arrester		x2					
Clean Governor Linkage		x2					
Check Spark Plug			x				
Replace Spark Plug				x			
Change Crankcase Oil			x3				
Clean Crankcase Breather			x2				
Clean Fuel Filter			x2				
Check Water Pump Impeller			x				
Check Battery Electrolyte Level		x					
Inspect Magneto Breaker Points				x5			
Clean Commutator and Slip Rings				x2			
Check Brushes				x4			
Check Valve Clearance					x5		
Remove Carbon and Lead					x5		

x1 - With unit running, visually and audibly check exhaust and fuel systems for leaks. Repair immediately.

x2 - Perform more often in extremely dusty conditions.

x3 - Change oil every 100 hours of operation or 3 months, whichever occurs first. Reduce schedule if operating in dusty or dirty conditions.

x4 - For minimum brush lengths, see *Generator Brushes*.

x5 - For detailed information, contact your nearest, authorized Onan service center.

**WARNING** All exhaust system connections **MUST** be checked regularly for any leaks and tightened as necessary. Do **NOT** terminate exhaust pipe near any window or bulkhead (door) openings. Do **NOT** use the air cleaner/flame arrester as a supporting step. Always operate bilge blower for 5 minutes after refueling or anytime prior to starting engines or generator set.

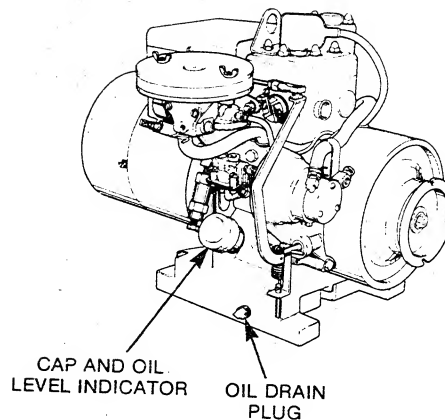
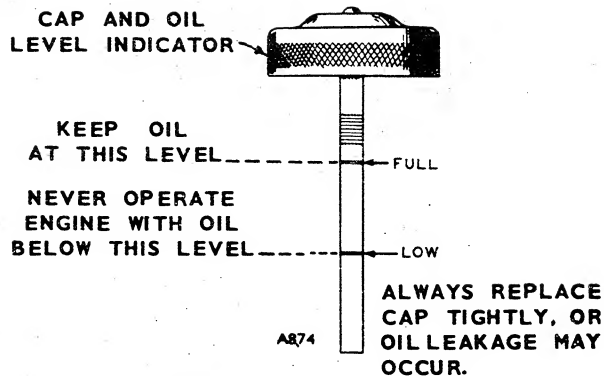


FIGURE 19. OIL LEVEL INDICATOR AND OIL DRAIN PLUG

## CRANKCASE OIL

Oil capacity of the MAJ generator set is 3.5 U.S. pints (1.66 lit). Fill the crankcase until the oil reaches the full mark on the oil level indicator (Figure 19). Use an oil with the API (American Petroleum Institute) designation SE or SE/CC. If not available, SD or SD/CC designated oil can be used.

Note the location of the oil drain in Figure 19.

**WARNING** Never attempt to check the oil level while the engine is running. Hot oil discharged from the engine could cause personal burns.

If operating in dusty or dirty conditions, change oil more often than shown in the maintenance schedule. When adding oil between changes, use the same brand as in the crankcase. Various brands of oil might not be compatible when mixed together.

Oil consumption may be higher with a multi-grade oil than a single-grade oil if both oils have comparable viscosities at 210°F (99°C). Therefore, single-grade oils are more desirable unless anticipating a wide range of temperatures. Use the proper grade oil for the expected temperature.

Above 90 F (32 C) ..... SAE 50  
32 to 90 F (0 to 32 C) ..... SAE 30  
0 to 32 F (-18 to 0 C) ..... SAE 10W-40, 5W-30  
Below 0 F (-18 C) ..... SAE 5W-30

## CRANKCASE BREATHER

Remove the breather tube and breather valve from the engine (Figure 20). If necessary, wash the hose and valve in a petroleum-base solvent to clean. Dry and reinstall the hose and valve on the engine.

### WARNING

Use extreme care when cleaning with a petroleum-base cleaner due to the fire hazard.

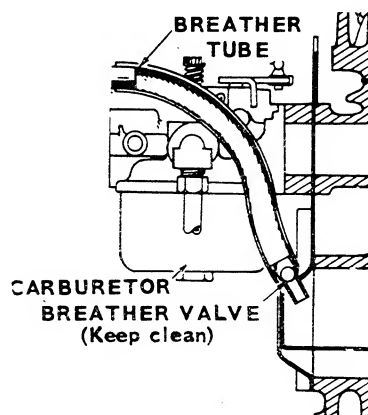


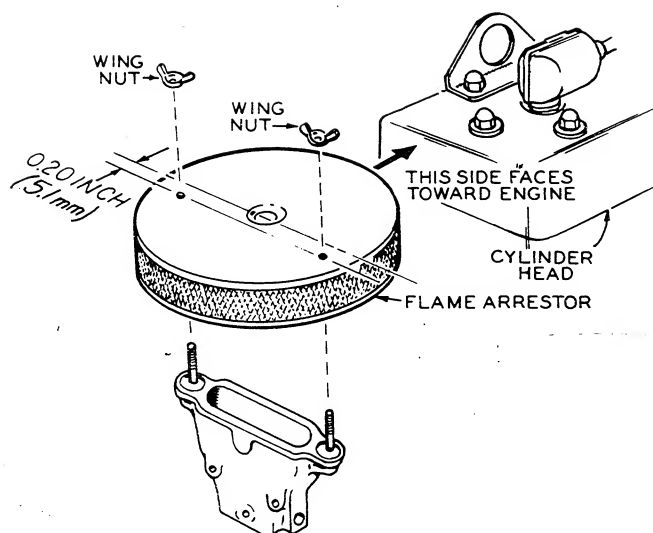
FIGURE 20. CRANKCASE BREATHER

## FLAME ARRESTER

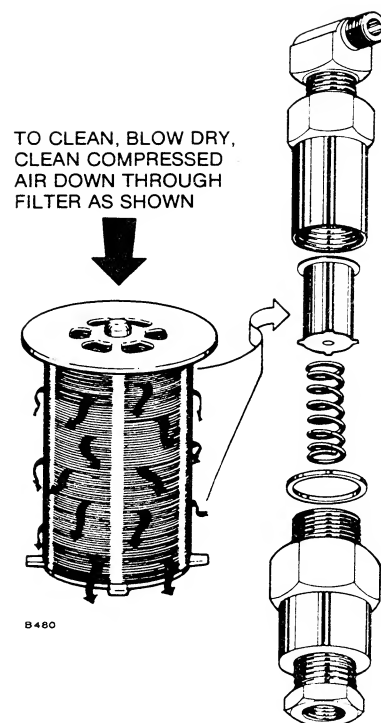
Check the flame arrester and if dirty, remove the flame arrester element from the engine (Figure 21). Wash the flame arrester in soap and water, rinse with clean water, and air dry with compressed air. Then re-install the flame arrester long side toward the engine. Fasten the wing nuts until they just contact the flame arrester, then tighten one full turn.

### CAUTION

Too much torque will distort the flame arrester.



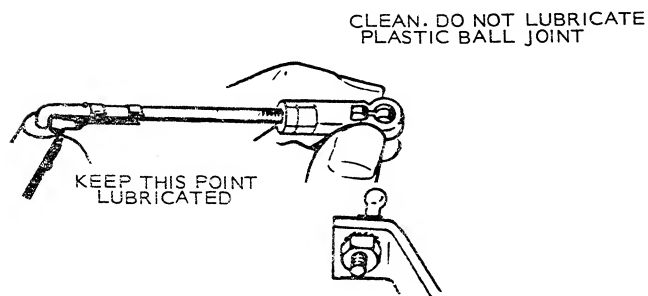
**FIGURE 21. REMOVAL OF RESONATOR AND FLAME ARRESTER**



**FIGURE 23. FUEL FILTER ASSEMBLY**

## GOVERNOR LINKAGE

Lubricate the governor linkage at the carburetor with powdered graphite (preferably), or a light, sewing machine type oil. See Figure 22. Do not lubricate the plastic ball joints, just clean them.



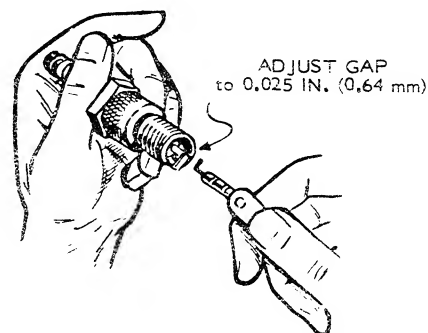
**FIGURE 22. GOVERNOR LINKAGE**

## FUEL FILTER

Every 200 hours, remove the fuel filter from the fuel filter assembly (Figure 23). Blow low pressure, clean and dry compressed air down through the center of the filter (outlet side). This should blow any particulate out the filter sides. Remember to install the filter with the openings on one end toward the fuel outlet (toward fuel pump).

## SPARK PLUG

Each time the spark plug is removed, inspect, clean, and regap it (Figure 24). If the plug looks discolored or has fouled, replace it. After 200 hours of operation, replace the spark plug.



**FIGURE 24. GAPPING SPARK PLUG**

## WATER PUMP IMPELLER

Remove the cover of the water pump (Figure 25) and inspect the neoprene impeller. If worn or damaged, install a new impeller. The pump should discharge a nominal 3.4 quarts (3.2 lit) per minute when the engine thermostat is open. When re-installing the water pump cover, make sure the cover is air tight to prevent early pump impeller failure. Tighten the cover screws 15 to 17 inch-pounds (1.70 to 1.92 N•m).

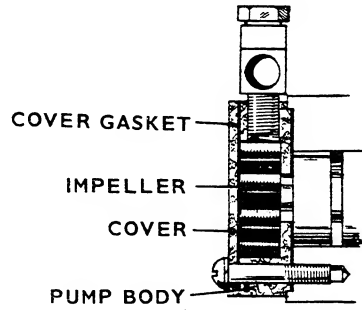


FIGURE 25. WATER PUMP ASSEMBLY

## GENERATOR BRUSHES

To expose the brush rig with the brushes, remove the generator end cover. Measure the commutator or DC brush (see Figure 26) and have replaced when worn to

5/8 inch (15.9 mm). Measure the AC brush shown in Figure 26 and have replaced when worn to 5/16 inch (8.0 mm).

Contact your nearest, authorized Onan service center for more information.

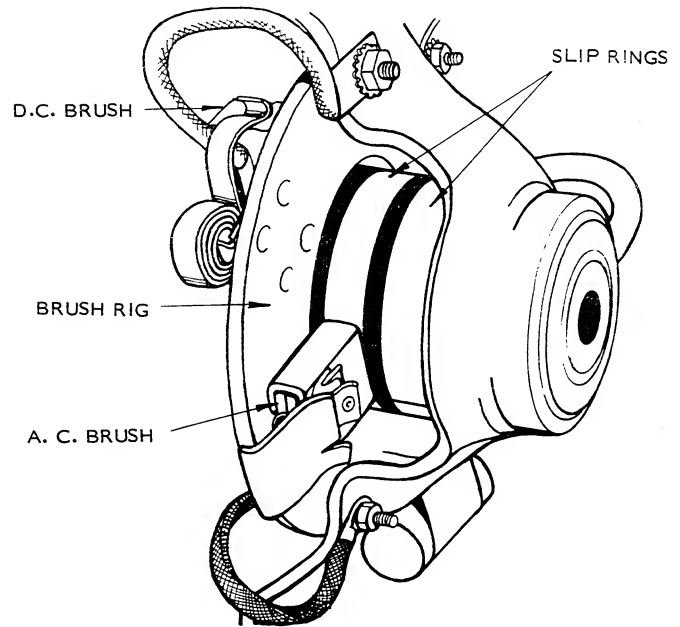


FIGURE 26. LOCATION OF GENERATOR BRUSHES

# ADJUSTMENTS

## CARBURETOR

If the carburetor is completely out of adjustment, turn the idle adjustment needle A (Figure 27) and main adjustment needle B in gently onto their seats. Do not use force—tight seating causes damage. Back off idle needle A one turn and main needle B 2-1/2 turns to permit starting.

Start the generator set and allow it to warm up. With a large load (do not overload) connected, turn main needle B in slowly until the engine begins to lose speed (or voltage drops). Then turn the needle back out to the point where the generator set will carry the load. Check operation under various loads. If there is any tendency to hunt (sudden increase and drop in speed), turn the needle B (out) to the point where operation is steady. Do not turn out more than 1/2 turn past the point of smooth full-load operation. Continuous unstable operation may be due to improper governor adjustment.

Remove the load from the generator set. Turn idle needle A in slowly until the engine loses speed. Then turn the needle out to the point of smooth operation. With the generator set still running with no load, turn the throttle lever stop screw C so it just touches the stop lever, then back off one full turn.

## GOVERNOR

The governor controls engine speed and engine speed determines the voltage and frequency of the generator current. Binding at any point of the governor, linkage, or carburetor throttle, causes slow governor action. Loose or worn parts cause erratic governor action.

**Make sure the carburetor is properly adjusted before attempting governor adjustment.**

With the generator set stopped, the length of linkage A shown in Figure 28 (with tension on spring B) must allow the carburetor throttle stop lever to just clear (maximum 1/32 inch or 7.9 mm) the carburetor body (Figure 27). Alter linkage length by turning the ball joint on the threaded rod. Run the generator set under load to thoroughly warm it up.

Connect a voltmeter across the generator output. With the generator set operating at no-load, adjust the speed nut C (Figure 28) for a voltmeter reading of 126 volts for a 120-volt unit. The voltage should not fall below 108 volts for a 120-volt unit under full-rated load.

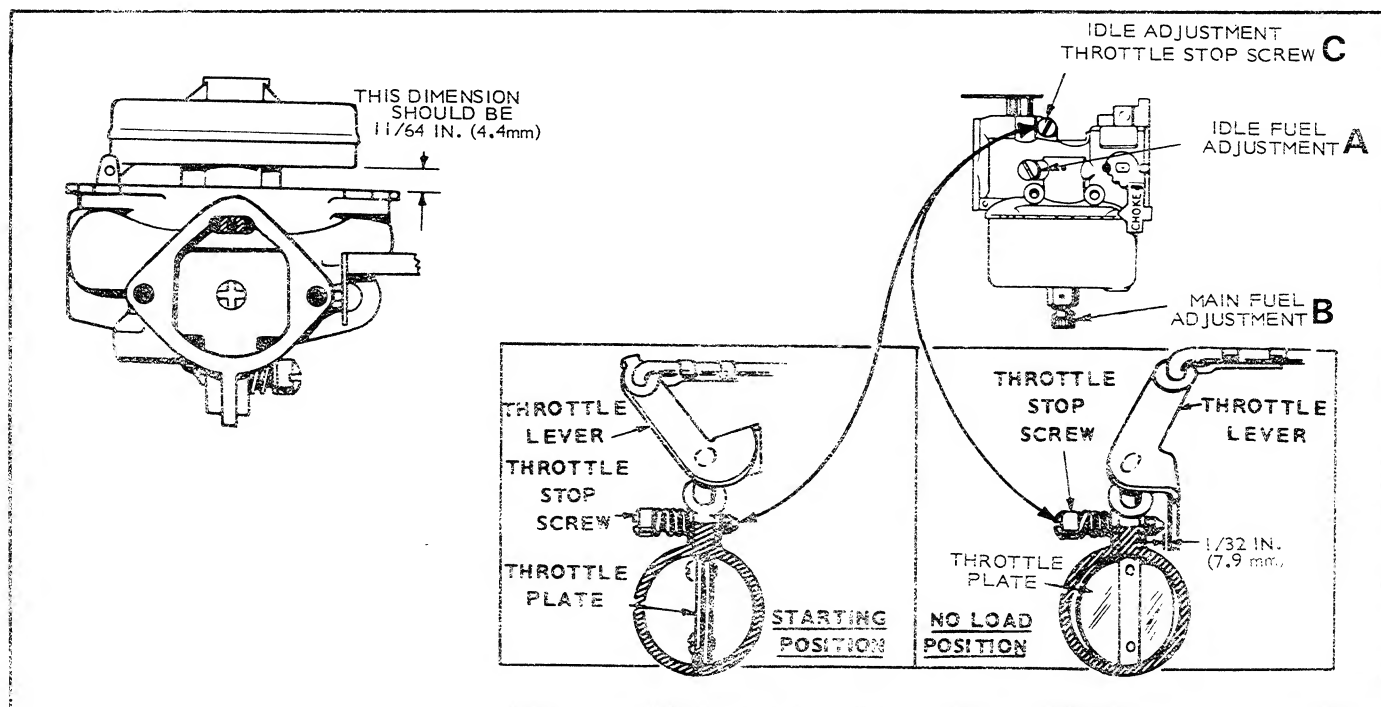


FIGURE 27. CARBURETOR ADJUSTMENTS

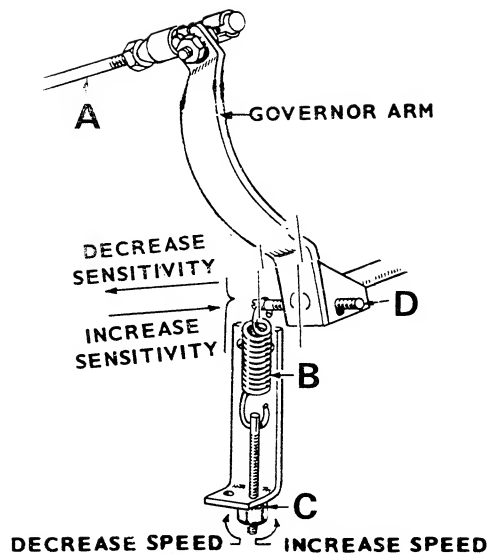


FIGURE 28. GOVERNOR ADJUSTMENTS

If voltage drop from load to no-load is too great, turn sensitivity screw D clockwise (Figure 28). If voltage drop is within the above limits but unsteady with a

tendency to alternately increase and decrease, turn the sensitivity screw counterclockwise. Any change in the sensitivity screw D setting requires a compensating change in the speed adjustment nut C.

## AUTOMATIC CHOKE

Normal choke setting is in slightly closed position at 70° F (21° C). If temperature changes require choke adjustment, loosen two screws at A (Figure 29). Turn the cover assembly counterclockwise to decrease choking. To increase choking, turn clockwise. Tighten both screws to lock cover in place.

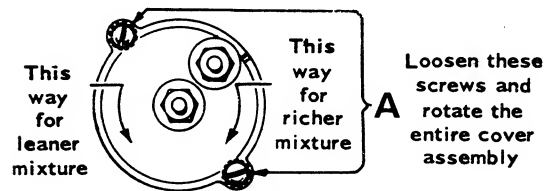


FIGURE 29. CHOKE ADJUSTMENT

# ENGINE TROUBLESHOOTING

TROUBLE	CAUSE														
	Backfire at Carburetor	Bearing Wear	Black Exhaust	Blue Exhaust	Burned Valves	Connecting Rod Wear	Crankshaft Slowly	Cylinder Wear	Engine Stops	Governor Hunting	High Oil Pressure	Loss of Coolant	Mechanical Knocks	Misfiring	Overheating (Water Cooled)
GASOLINE ENGINE TROUBLESHOOTING GUIDE															
STARTING SYSTEM															
															Loose or Corroded Battery Connection
															Low or Discharged Battery
															Faulty Starter
															Faulty Start Solenoid
IGNITION SYSTEM															
															Ignition Timing Wrong
															Wrong Spark Plug Gap
															Worn Points or Improper Gap Setting
															Bad Ignition Coil or Condenser
															Faulty Spark Plug Wires
FUEL SYSTEM															
															Out of Fuel - Check
															Lean Fuel Mixture - Readjust
															Rich Fuel Mixture or Choke Stuck
															Engine Flooded
															Poor Quality Fuel
															Dirty Carburetor
															Dirty Air Cleaner
															Dirty Fuel Filter
															Defective Fuel Pump
INTERNAL ENGINE															
															Wrong Valve Clearance
															Broken Valve Spring
															Valve or Valve Seal Leaking
															Piston Rings Worn or Broken
															Wrong Bearing Clearance
COOLING SYSTEM (AIR COOLED)															
															Poor Air Circulation
															Dirty or Oily Cooling Fins
															Blown Head Gasket
COOLING SYSTEM (WATER COOLED)															
															Insufficient Coolant
															Faulty Thermostat
															Worn Water Pump or Pump Seal
															Water Passages Restricted
															Defective Gaskets
															Blown Head Gasket
LUBRICATION SYSTEM															
															Defective Oil Gauge
															Relief Valve Stuck
															Faulty Oil Pump
															Dirty Oil or Filter
															Oil Too Light or Diluted
															Oil Level Low
															Oil Too Heavy
															Dirty Crankcase Breather Valve
THROTTLE AND GOVERNOR															
															Linkage Out of Adjustment
															Linkage Worn or Disconnected
															Governor Spring Sensitivity Too Great
															Linkage Binding



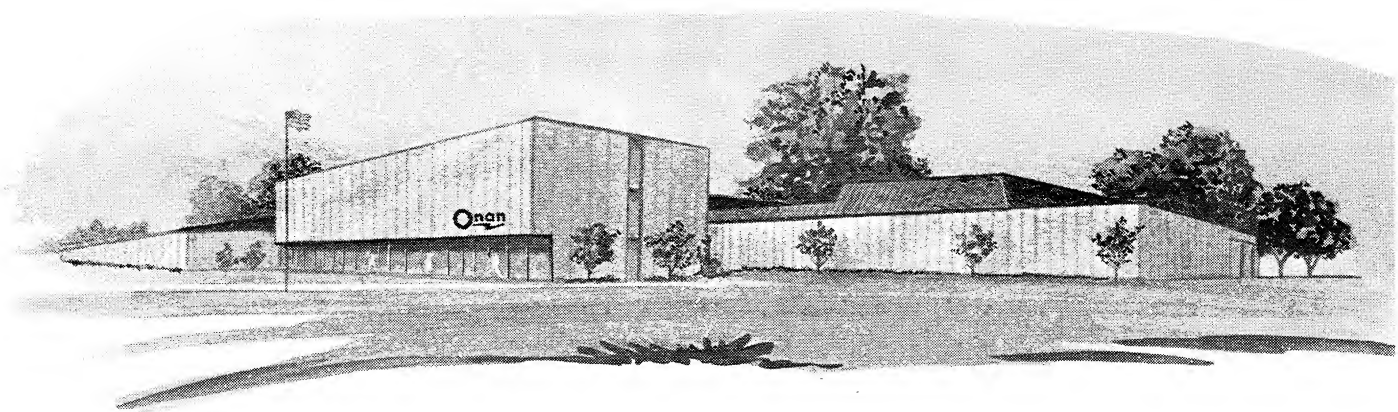
# PARTS INFORMATION

The following replacement parts consist of items which can be usually installed by the operator. For additional information on parts or service, contact your nearest authorized Onan dealer or service center. A complete parts manual is available for a nominal charge and can be ordered under part number 933-0220.

Breaker Point Set.....	160-0540
Condenser (Ignition).....	312-0033
Spark Plug .....	167-0028
Start Solenoid .....	307-1046
Thermostat.....	309-0298*
Thermostat Spring.....	309-0088
Thermostat Cover Plate Gasket.....	309-0004
Crankcase Breather Hose .....	503-0557
Crankcase Breather Valve.....	123-0486
Fuel Pump .....	149-0693
Fuel Pump Mounting Gasket .....	149-0003
Carburetor .....	146-0093
Carburetor Mounting Gasket .....	145-0110
Water Pump Impeller Assembly .....	131-0050
Water Pump Cover Gasket .....	131-0044
Governor Spring.....	150-0098
Cylinder Head Gasket .....	110-0940
DC Brush (Two Used) .....	214-0070
DC Brush Spring (Two Used) .....	212-1011
AC Brush	
120-Volt Unit (Two Used) .....	214-0072
240-Volt Unit (Three Used).....	214-0073
AC Brush Spring and Support	
(One for Each AC Brush) .....	212-1105
Unit Vibration Mount .....	402-0261

\* For MAJ generator sets prior to serial number 7601618197, use 309-0298 thermostat and new 309-0301 thermostat cover.





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